CLAIMS

WHAT IS CLAIMED IS:

1. An abrasive slurry capable of use in a chemical mechanical polishing operation, comprising:

a plurality of abrasive particles;

a matrix capable of carrying the plurality of abrasive particles; and

a gettering agent having an affinity for a material removed in the chemical mechanical polishing operation.

2. An abrasive slurry, according to claim 1, wherein at least a portion of the plurality of abrasive particles are selected from the group consisting of alumina, colloidal silica, fumed silica, ceria, and diamond.

3. An abrasive slurry, according to claim 1, wherein the gettering agent has an affinity for copper.

4. An abrasive slurry, according to claim 1, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

5. A rinsing fluid capable of use in a post-chemical mechanical polishing rinsing cycle, comprising a gettering agent having an affinity for a residue material resulting from a chemical mechanical polishing operation.

6. A rinsing fluid, according to claim 5, wherein the gettering agent has an affinity for copper.

7. A rinsing fluid, according to claim 5, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

8. A chemical mechanical polishing method, comprising:

applying an abrasive slurry comprising a gettering agent to a polishing pad, the gettering agent having an affinity for a material to be removed; and

causing a relative motion between a process layer on a wafer and the polishing pad while the polishing pad is in contact with the process layer, wherein the abrasive slurry is contacts the process layer and the polishing pad.

9. A chemical mechanical polishing method, according to claim 8, wherein the gettering agent has an affinity for copper.

10. A chemical mechanical polishing method, according to claim 8, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

11. A chemical mechanical polishing method, according to claim 8, further comprising regulating an amount of the gettering agent in the abrasive slurry according to a desired material removal rate.

12. A chemical mechanical polishing method, according to claim 11, wherein regulating the amount of the gettering agent comprises:

increasing the amount of the gettering agent in the abrasive slurry to increase a material removal rate; and

decreasing the amount of the gettering agent in the abrasive slurry to decrease the material removal rate.

13. A chemical mechanical polishing method, according to claim 8, further comprising regulating a material removal rate according to an equation:

$$\frac{\ddot{A}x}{\ddot{A}t} = Kp \cdot \frac{F}{A} \cdot v \cdot Eg$$

wherein:

$\frac{\ddot{A}x}{\ddot{A}t}$ = the material removal rate;

Kp = an empirically-determined scale factor;

F = a force applied between the polishing pad and the process layer on the wafer;

A = an area between the polishing pad and the process layer on the wafer;

v = a relative linear velocity of the wafer with respect to the polishing pad; and

Eg = an erosion factor due to the gettering agent.

14. A chemical mechanical polishing method, comprising:

applying an abrasive slurry to a polishing pad;

causing a relative motion between a wafer and the polishing pad for a period of time while the polishing pad is in contact with the wafer, wherein the abrasive slurry is in contact with the wafer and the polishing pad; and

introducing a gettering agent into the abrasive slurry at a predetermined time during the period of time.

15. A chemical mechanical polishing method, according to claim 14, wherein the gettering agent has an affinity for copper.

16. A chemical mechanical polishing method, according to claim 14, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

17. A chemical mechanical polishing method, according to claim 14, wherein the gettering agent is introduced at a beginning of the period of time.

18. A chemical mechanical polishing method, according to claim 14, wherein the gettering agent is introduced at an intermediate time during the period of time.

19. A chemical mechanical polishing method, according to claim 14, wherein the gettering agent is introduced near an end of the period of time.

20. A chemical mechanical polishing method, according to claim 14, further comprising regulating an amount of the gettering agent introduced into the abrasive slurry according to a desired material removal rate.

21. A chemical mechanical polishing method, according to claim 20, wherein regulating the amount of the gettering agent comprises:

increasing the amount of the gettering agent introduced into the abrasive slurry to increase a material removal rate; and

decreasing the amount of the gettering agent introduced into the abrasive slurry to decrease the material removal rate.

22. A chemical mechanical polishing method, according to claim 14, further comprising regulating a material removal rate according to an equation:

$$\frac{\ddot{A}x}{\ddot{A}t} = Kp \cdot \frac{F}{A} \cdot v \cdot Eg$$

wherein:

$\frac{\ddot{A}x}{\ddot{A}t}$ = a material removal rate;

Kp = an empirically-determined scale factor;

F = a force applied between a polishing pad and a process layer on a wafer;

A = an area between the polishing pad and the process layer on the wafer;

v = a relative linear velocity of the wafer with respect to the polishing pad; and

Eg = an erosion factor due to the gettering agent.

23. A rinsing method, comprising rinsing a wafer with a rinsing fluid comprising a gettering agent having an affinity for a residue material.

24. A rinsing method, according to claim 23, wherein the gettering agent has an affinity for copper.

25. A rinsing method, according to claim 23, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

26. A rinsing method, according to claim 23, further comprising regulating an amount of the gettering agent in the rinsing fluid based upon a desired residue material removal rate.

27. A rinsing method, according to claim 26, wherein regulating the amount of the gettering agent comprises:

increasing the amount of the gettering agent in the rinsing fluid to increase a residue material removal rate; and

decreasing the amount of the gettering agent in the rinsing fluid to decrease the residue material removal rate.

28. A rinsing method, according to claim 23, further comprising filtering the rinsing fluid.

29. A rinsing method, comprising:

rinsing a wafer with a rinsing fluid for a period of time; and

introducing a gettering agent into the rinsing fluid at a predetermined time during the period of time.

30. A rinsing method, according to claim 29, wherein the gettering agent has an affinity for copper.

31. A rinsing method, according to claim 29, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

32. A rinsing method, according to claim 29, wherein the gettering agent is introduced at a beginning of the period of time.

33. A rinsing method, according to claim 29, wherein the gettering agent is introduced at an intermediate time during the period of time.

34. A rinsing method, according to claim 28, wherein the gettering agent is introduced near an end of the period of time.

35. A rinsing method, according to claim 29, further comprising regulating an amount of the gettering agent introduced into the rinsing fluid according to a desired residue material removal rate.

36. A rinsing method, according to claim 35, wherein regulating the amount of the gettering agent comprises:

increasing the amount of the gettering agent introduced into the rinsing fluid to increase a residue material removal rate; and

decreasing the amount of the gettering agent introduced into the rinsing fluid to decrease the residue material removal rate.

37. A rinsing method, according to claim 29, further comprising filtering the rinsing fluid.

38. A chemical mechanical polishing system capable of using an abrasive slurry containing a gettering agent, comprising:

a wafer chuck capable of holding a semiconductor wafer;

a polishing pad capable of polishing a process layer on the semiconductor wafer; and

a controller capable of controlling an amount of the gettering agent in the abrasive slurry.

39. A chemical mechanical polishing system, according to claim 38, further comprising a gettering agent injector capable of injecting the gettering agent into the abrasive slurry, wherein the controller is interconnected with the gettering agent injector to control the amount of the gettering agent injected into the abrasive slurry.

40. A chemical mechanical polishing system, according to claim 38, wherein the controller controls the amount of the gettering agent in the abrasive slurry based upon a desired material removal rate.

41. A chemical mechanical polishing system, according to claim 38, wherein the controller is capable of controlling a polishing operation performed by the chemical mechanical polishing system according to an equation:

$$\frac{\ddot{A}x}{\ddot{A}t} = Kp \cdot \frac{F}{A} \cdot v \cdot Eg$$

wherein:

$\frac{\ddot{A}x}{\ddot{A}t}$ = a material removal rate;

Kp = an empirically-determined scale factor;

F = a force applied between the polishing pad and the process layer on a wafer;

A = an area between the polishing pad and the process layer on the wafer;

v = a relative linear velocity of the wafer with respect to the polishing pad; and

Eg = an erosion factor due to the gettering agent.

42. A rinsing system capable of using a rinsing fluid containing a gettering agent, comprising:

a wafer chuck capable of holding a semiconductor wafer;

a nozzle capable of spraying the semiconductor wafer with the rinsing fluid; and

a controller capable of controlling an amount of the gettering agent in the rinsing fluid.

43. A rinsing system, according to claim 42, further comprising a gettering agent injector capable of injecting the gettering agent into the rinsing fluid, wherein the controller is interconnected with the gettering agent injector to control the amount of the gettering agent injected into the rinsing agent.

44. A rinsing system, according to claim 42, wherein the controller controls the amount of the gettering agent in the rinsing agent based upon a desired material removal rate.

45. A rinsing system, according to claim 42, further comprising a circulating filtration system capable of filtering the rinsing fluid.

46. A chemical mechanical polishing apparatus, comprising:

means for applying an abrasive slurry comprising a gettering agent to a polishing pad, the gettering agent having an affinity for a material to be removed; and

means for causing a relative motion between a process layer on a wafer and the polishing pad while the polishing pad is in contact with the process layer, wherein the abrasive slurry is between the process layer and the polishing pad.

47. A chemical mechanical polishing apparatus, according to claim 46, wherein the gettering agent has an affinity for copper.

48. A chemical mechanical polishing apparatus, according to claim 46, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions,

bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

49. A chemical mechanical polishing apparatus, according to claim 46, further comprising means for regulating an amount of the gettering agent in the abrasive slurry according to a desired material removal rate.

50. A chemical mechanical polishing apparatus, according to claim 49, wherein the means for regulating the amount of the gettering agent comprises:

means for increasing the amount of the gettering agent in the abrasive slurry to increase a material removal rate; and

means for decreasing the amount of the gettering agent in the abrasive slurry to decrease the material removal rate.

51. A chemical mechanical polishing apparatus, according to claim 46, further comprising means for regulating a material removal rate according to an equation:

$$\frac{\ddot{A}x}{\ddot{A}t} = Kp \cdot \frac{F}{A} \cdot v \cdot Eg$$

wherein:

$\frac{\ddot{A}x}{\ddot{A}t}$ = a material removal rate;

Kp = an empirically-determined scale factor;

F = a force applied between the polishing pad and the process layer on the wafer;

A = an area between the polishing pad and the process layer on the wafer;

v = a relative linear velocity of the wafer with respect to the polishing pad; and

Eg = an erosion factor due to the gettering agent.

52. A chemical mechanical polishing apparatus, comprising:

means for applying an abrasive slurry to a polishing pad;

means for causing a relative motion between a wafer and the polishing pad while the polishing pad is in contact with the wafer, wherein the abrasive slurry is between the wafer and the polishing pad; and

means for introducing a gettering agent into the abrasive slurry at a predetermined time during the period of time.

53. A chemical mechanical polishing apparatus, according to claim 52, wherein the gettering agent has an affinity for copper.

54. A chemical mechanical polishing apparatus, according to claim 52, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

55. A chemical mechanical polishing apparatus, according to claim 52, wherein the gettering agent is introduced at a beginning of the period of time.

56. A chemical mechanical polishing apparatus, according to claim 52, wherein the gettering agent is introduced at an intermediate time during the period of time.

57. A chemical mechanical polishing apparatus, according to claim 52, wherein the gettering agent is introduced near an end of the period of time.

58. A chemical mechanical polishing apparatus, according to claim 52, further comprising means for regulating an amount of the gettering agent introduced into the abrasive slurry according to a desired material removal rate.

59. A chemical mechanical polishing apparatus, according to claim 58, wherein the means for regulating the amount of the gettering agent comprises:

means for increasing the amount of the gettering agent introduced into the abrasive slurry to increase a material removal rate; and

means for decreasing the amount of the gettering agent introduced into the abrasive slurry to decrease the material removal rate.

60. A chemical mechanical polishing apparatus, according to claim 52, further comprising means for regulating a material removal rate according to an equation:

$$\frac{\ddot{A}x}{\ddot{A}t} = Kp \cdot \frac{F}{A} \cdot v \cdot Eg$$

wherein:

$\frac{\ddot{A}x}{\ddot{A}t}$ = a material removal rate;

Kp = an empirically-determined scale factor;

F = a force applied between the polishing pad and the process layer on a wafer;

A = an area between the polishing pad and the process layer on the wafer;

v = a relative linear velocity of the wafer with respect to the polishing pad; and

Eg = an erosion factor due to the gettering agent.

61. A rinsing apparatus, comprising means for rinsing a wafer with a rinsing fluid comprising a gettering agent having an affinity for a residue material.

62. A rinsing apparatus, according to claim 61, wherein the gettering agent has an affinity for copper.

63. A rinsing apparatus, according to claim 61, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate (EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

64. A rinsing apparatus, according to claim 61, further comprising means for regulating an amount of the gettering agent in the rinsing fluid based upon a desired residue material removal rate.

65. A rinsing apparatus, according to claim 64, wherein the means for regulating the amount of the gettering agent comprises:

means for increasing the amount of the gettering agent in the rinsing fluid to increase a residue material removal rate; and

means for decreasing the amount of the gettering agent in the rinsing fluid to decrease the residue material removal rate.

66. A rinsing apparatus, comprising:

means for rinsing a wafer with a rinsing fluid; and

means for introducing a gettering agent into the rinsing fluid at a predetermined time during the period of time.

67. A rinsing apparatus, according to claim 66, wherein the gettering agent has an affinity for copper.

68. A rinsing apparatus, according to claim 66, wherein the gettering agent is selected from the group consisting of ethylene diamine, ethylene diaminetetraacetate

(EDTA) ions, oxalate ions, ortho-phenanthroline, carbonate ions, bipyridine, pyridine, thiourea, cyanide, an oxidizing acid, a sulfur-bearing compound, and ammonia.

69. A rinsing apparatus, according to claim 66, wherein the gettering agent is introduced at a beginning of the period of time.

70. A rinsing apparatus, according to claim 66, wherein the gettering agent is introduced at an intermediate time during the period of time.

71. A rinsing apparatus, according to claim 66, wherein the gettering agent is introduced near an end of the period of time.

72. A rinsing apparatus, according to claim 66, further comprising means for regulating an amount of the gettering agent introduced into the rinsing fluid according to a desired residue material removal rate.

73. A rinsing apparatus, according to claim 72, wherein the means for regulating the amount of the gettering agent comprises:

means for increasing the amount of the gettering agent introduced into the rinsing fluid to increase a residue material removal rate; and

means for decreasing the amount of the gettering agent introduced into the rinsing fluid to decrease the residue material removal rate.

74. A rinsing apparatus, according to claim 66, further comprising a circulating filtration system capable of filtering the rinsing fluid.